PRELIMINARY SOILS INVESTIGATION

KAOPA SUBDIVISION UNIT 3B

KAILUA, OAHU, HAWAII

TMK: 4-2-02: 3
4-2-04: 1

for

LONE STAR HAWAII, INC.

W. O. 378

December 1, 1977

ERNEST K. HIRATA & ASSOCIATES, INC.

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering

1236 South King Street • Honolulu, Hawaii 96814 • Phone 531-5733

December 1, 1977
W. O. 378

Lone Star Hawaii, Inc.
Suite 1480
Pacific Trade Center
190 South King Street
Honolulu, Hawaii 96813

Attention: Mr. Gail Sims

Gentlemen:

Our report, "Preliminary Soils Investigation, Kaopa Subdivision Unit 3B, Kailua, Oahu, Hawaii, TMK: 4-2-02: 3 & 4-2-04: 1", dated December 1, 1977, our Work Order 378 is enclosed.

Subsurface soil conditions were found to be variable throughout the length of the site. The soils underlying the site vary from soft and loose clayey silts and sand silt mixtures to firm silty clays. Although soil conditions are variable, it is our opinion that the site can be developed provided proper construction procedures and sufficient time is allowed to permit consolidation of the soft deposits.

Settlement predictions and anticipated time for 90 percent of the settlements to occur are presented in this report. We recommend that settlement markers be installed during filling operations to monitor the anticipated settlements. The use of surcharging may be necessary and a final decision can be made after the first stage of filling has been completed.

In reviewing the possible methods of construction at the lake front, we would recommend the use of a rock slope protection in lieu of a rock retaining wall.

We appreciate this opportunity to be of service. Should you have any questions conerning this report, please feel free to call on us.

Very truly yours,

Ernest K. Hirata & Associates, Inc.

Ernest K. Hirata

Ernest K. Hirata President

EKH:yk

W. O. 378

PRELIMINARY SOILS INVESTIGATION

KAOPA SUBDIVISION UNIT 3B

KAILUA, OAHU, HAWAII

TMK: 4-2-02: 3
4-2-04: 1

INTRODUCTION

The following report presents the results of our preliminary soils investigation conducted on the subject property. A Grading Plan showing the area covered by this investigation and the approximate location of borings is enclosed in the Appendix. Previous boring locations performed in May of 1974 are also shown on the Grading Plan.

This investigation was authorized to review all past data obtained from previous investigations, to perform additional subsurface field work, to evaluate present soil conditions, and to provide recommendations for the development of the project.

PROPOSED GRADING AND DEVELOPMENT

The grading plan calls for filling of the lake along Keolu Drive in two stages. The first stage will include placement of rock fill extending into the lake for a distance of 85 feet measured to the top of bank. Drain lines will be constructed

during the first stage.

The second stage of grading will include additional placement of fill extending to a maximum distance of 125 feet. The final elevation of the fill along the new lake boundary will be at elevation +6. A rock revetment will probably be used adjacent to the lake.

SITE CONDITIONS

The property is located on the lakeside parallel to Keolu Drive between Akiahala Street and Akea Place. An existing berm is located in the lake and was used as a silting basin for previous grading in the area. The berm is heavily overgrown with brush and weeds.

FIELD EXPLORATION

Field exploration was performed between October 5th and 8th, 1976 by drilling four exploratory test borings with a portable drilling machine. The borings varied in depth from 21.5 to 30 feet and were drilled on the existing berm. The soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System. The boring locations are shown on the Grading Plan, and the soils encountered are logged on Plates A1 through A4.

Undisturbed and bag samples were obtained from the borings for laboratory testing and analyses. Undisturbed samples were obtained by driving a 3 inch O.D. thin-walled split tube sampler with a 140 pound hammer from a height of 30 inches. The required blow count for each six inches of penetration is shown on the enclosed Boring Logs.

SOIL CONDITIONS

Our exploratory borings indicate that the soils underlying the site vary from soft and loose clayey silts and sand-silt mixtures to firm silty clays. The soils can be classified as alluvium deposits.

The upper 2 to 4 feet of surface material comprising the berm is a clayey silt placed during the construction of the silting basin. Underlying the surface soil is a layer of soft dark gray organic clay. Our borings found the thickness of the layer to range from 3 to 4 feet although previous borings have encountered thicknesses ranging from 1.5 feet to 4.5 feet. Underlying the organic clayey silt is varying strata of sandy and clayey silts with coral fragments and firm silty clays.

CONCLUSIONS AND RECOMMENDATIONS

Subsurface soil conditions were found to be variable throughout the length of the site. Although soil conditions are variable, it is our opinion that the site can be developed provided proper construction procedures and sufficient time is allowed to permit consolidation of the soft deposits.

Time rate consolidations were taken of the subsurface materials. Settlement calculations were then computed for two cases. Case I calculations assume that the organic clayey silt is not removed while Case II assumes removal of the organic layer. The following presents the range of settlement that can be anticipated due to addition of fill material.

	Range of Settlements nearest Keolu Drive	Range of Settlements at edge of fill
Case I w/organic layer	6" ~ 17"	$4\frac{1}{4}$" ~ $11\frac{1}{2}$"
Case II w/o organic layer	$3\frac{1}{2}$" ~ 11-3/4"	$2\frac{1}{4}$" ~ $7\frac{1}{2}$"

As can be seen from the above results, much larger settlements can be anticipated if the organic layer is not removed. The anticipated time for 90 percent of the settlements to occur was found to be approximately two years for either case.

Since grading operations will create some mud wave effect fronting the filling operation, we would recommend the removal

of the mud wave as it develops.

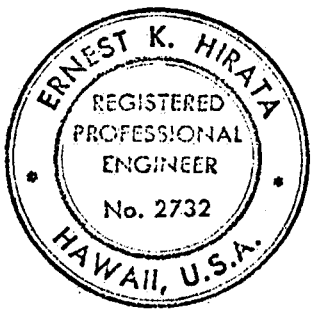
During filling operations, settlement markers should be placed at intervals of approximately 200 feet in order to monitor the anticipated settlements. Plate 2 presents a settlement gage detail which may be utilized for monitoring of the fill.

We would also recommend the use of surcharging to accelerate the time for the settlement to occur. The use of surcharging may be decided after the first stage of filling has been completed. Final decision as to height of surcharging will be based on actual settlement readings.

Boulder fill may be used up to a maximum of one foot above the existing water table. A minimum of 12 inches of granular fill should then be placed over the boulder fill. Imported borrow material may then be placed in thin lifts and compacted to a minimum of 90 percent relative compaction.

Upon review of possible methods of construction at the lake front, we would recommend the use of a rock revetment for slope protection in lieu of a rock retaining wall. The weight of a rock retaining wall will be considerably heavier causing greater settlement along the lake front. A slope stability analysis was performed using a slope gradient of 2:1 (horizontal to vertical), and a factor of safety in

excess of 1.5 was obtained. Plate 1 presents a typical rock-slope protection that may be used.



Respectfully submitted,

Ernest K. Hirata & Associates, Inc.

Ernest K. Hirata P.E. 2732

EKH:yk

Enc: Appendix of Laboratory Testing
Log of Borings Plates A1 through A4
Consolidation Test Reprt Plates B1 through B6
Typical Rock Slope Protection Plate 1
Settlement Gage Detail Plate 2
Grading Plan

APPENDIX OF LABORATORY TESTING

Classification

The field classification is verified in the laboratory, also in accordance with the Unified Soil Classification System. Laboratory classification is determined by both visual examination and Atterburg Limit Tests according to ASTM D423 and D424. The final classification is shown on the Boring Logs.

Moisture-Density

The field moisture content and dry unit weight are determined for each of the undisturbed soil samples. The information is useful in providing a gross picture of the soil consistency between borings and any local variations. The dry unit weight is determined in pounds per cubic foot while the moisture content is determined as a percentage of the dry unit weight. These samples are obtained from a 3" O.D. split tube sampler.

Consolidation

Settlement predictions of the soil's behavior under load are made on the basis of the consolidation tests. Loads are applied in several increments in a geometric progression, and the resulting deformations are recorded at selected time intervals. Porous stones are placed in contact with the top and bottom of each specimen having an inside diameter of 2.40 inches and a height of 1 inch to permit addition and

release of pore fluid. Results of undisturbed and remolded samples are plotted on the Consolidation Test Report.

Compaction Tests

Compaction tests were performed on bag samples to determine the optimum moisture content at which each type of proposed fill material compacts to 100% density. The tests were performed according to ASTM D-1557-70.

Swell Tests

Swell tests were performed to determine the expansiveness of the onsite surface soils. The tests were performed on undisturbed ring and remolded samples taking a one inch high specimen under different surcharge loads.

Shear Tests

Shear tests are performed in the Direct Shear Machine which is of the strain control type. The rate of deformation is approximately 0.02 inches per minute. Each sample is sheared under varying confining loads in order to determine the Coulomb shear strength parameters, cohesion and angle of internal friction. Eighty percent of the maximum value is taken to determine the shear strength parameters.

ERNEST K. HIRATA & ASSOCIATES, INC.
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BORING LOG

BORING NO. B1 DRIVING WT. 140 lb. DATE OF DRILLING 10-5-76

SURFACE ELEV. +2 DROP 30 in. W.O. 378

DEPTH FEET	CORE	BAG	PENETRATION RESIST. BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									Clayey SILT (ML)-Reddish brown, moist, soft to firm, sandy, with roots. Grading to grayish brown color from 1 foot.
	x		1 0 1	42.4	104.3				
									Clayey SILT (OL)-Dark gray, soft, organic.
5	x		1 1 1	60.7	72.7				Sandy SILT (ML) with CORAL FRAGMENTS-Light gray, soft and loose, with shell fragments.
	x		2 1 1	No Recovery					
10									
	x		2 2 1	No Recovery					
15									
	x		2 1 1	No Recovery					
20									
	x		1 1 1	52.9	71.7				Grading clayey at 25 feet.
25									
	x		1 1 4	72.0	50.6				End boring at 30 feet. ▽ Water level at 0.5 feet.
30									

Plate A1

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BORING LOG

BORING NO. B2 DRIVING WT. 140 lb. DATE OF DRILLING 10-6-76

SURFACE ELEV. +2.5 DROP 30 in. W.O. 378

DEPTH FEET	CORE	BAG	PENETRATION RESIST. BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS Ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
									Clayey SILT (ML)-Brown, moist, firm, with coral fragments and few roots.
	x		3 2 2	No Recovery					Clayey SILT (OL)-Dark gray, soft, organic, sandy.
5	x		3 2 2	37.9	129.3				Clayey SILT (MH)-Light gray, soft, with sand.
									Grading firm to medium stiff with coral fragments from 8.5 feet.
10	x		3 5 4	72.8	58.9				
									Grading gravelly with shell fragments from 15 feet.
15	x		3 1 2	84.3	33.9				
20	x		5 8 9	77.5	40.8				
									End boring at 21.5 feet.
									▽ Water level at 0.6 feet.
25									
30									

Plate A2

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BORING LOG

BORING NO. B3 DRIVING WT. 140 lb. DATE OF DRILLING 10-7-76

SURFACE ELEV. +3 DROP 30 in. W.O. 378

DEPTH FEET	CORE	BAG	PENETRATION RESIST. BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS Ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0 ▽									Clayey SILT (ML)-Brown, moist, soft to firm, sandy with few roots.
		x	1 0 1	31.8	157.7		5.5°	0.16 KSF	Clayey SILT (OL)-Dark gray, soft, sandy, with roots.
5		x	push	48.8	64.6				
			2 3						Sandy SILT (ML) with CORAL FRAGMENTS-Light gray, soft and loose, with shell fragments.
		x	3 1 1	No Recovery					
10									
									Grading to bluish gray color from 14 feet.
		x	2 1 2	No Recovery					
15									
		x	2 1 2	62.9	60.8				
20									
									Grading clayey from 23 feet.
		x	2 1 1	68.8	57.0				
25									
									End boring at 25.5 feet.
									▽ Water level at 1.0 feet.
30									

Plate A3

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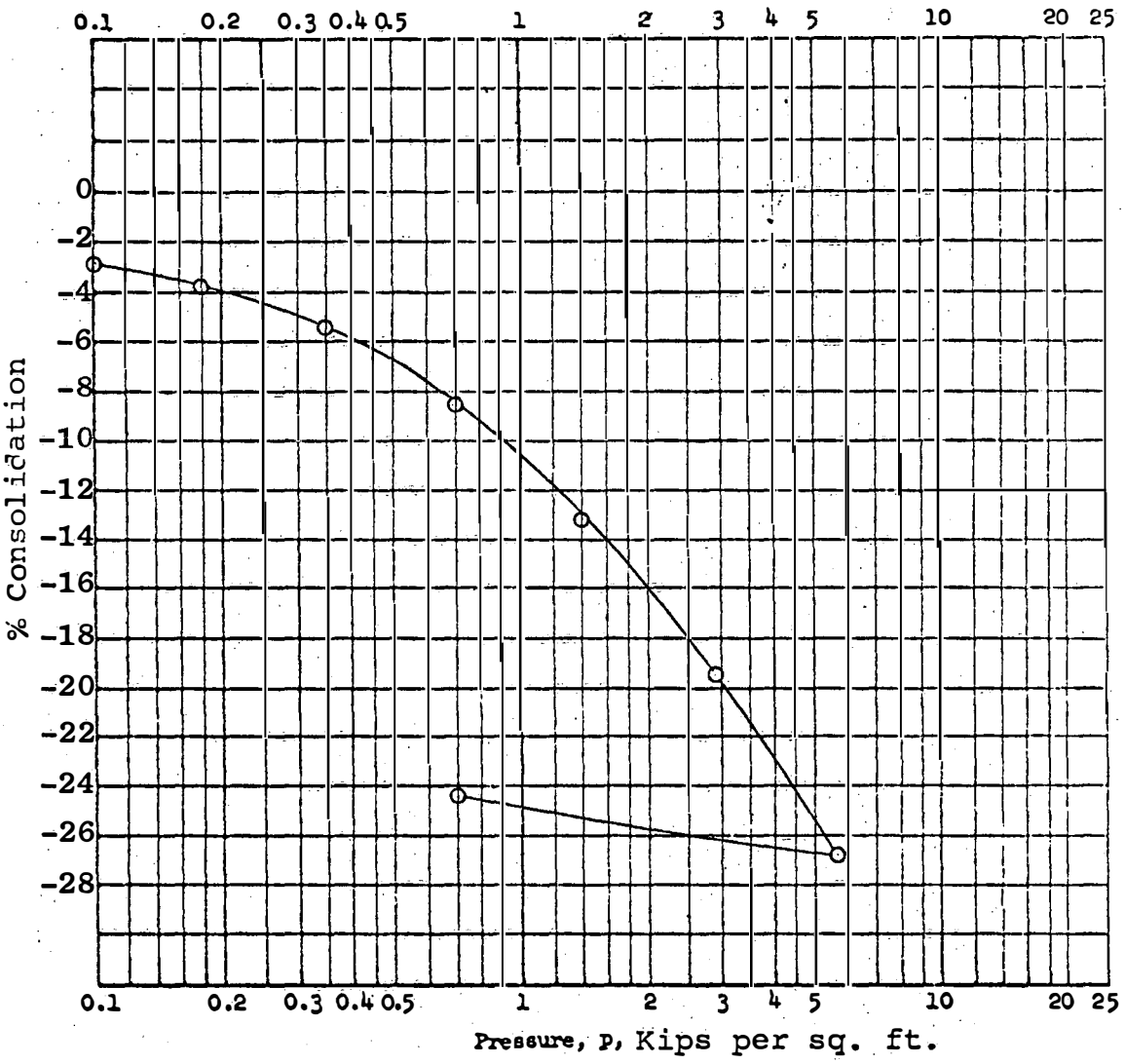
BORING LOG

BORING NO. B4 DRIVING WT. 140 lb. DATE OF DRILLING 10-8-76

SURFACE ELEV. +2 DROP 30 in. W.O. 378

DEPTH FEET	CORE	BAG	PENETRATION RESIST. BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
▽									Clayey SILT (ML)-Grayish brown, moist, firm, sandy, with coral fragments and roots.
	x		2 5 4	62.1	59.5		12°	0.81 KSF	Clayey SILT (OL)-Dark gray, soft, organic, sandy.
5									Sandy SILT (ML) with CORAL FRAGMENTS-Gray, loose to firm.
	x		2 4 5	56.4	49.1				Grading to bluish gray color from 8 feet. Few basalt fragments and shell fragments at 8.5 feet.
10									Grading to dense from 11 feet.
	x		10 13 14	110.8	13.8				
15									
	x		5 3 4	No Recovery					Silty CLAY (MH)-Bluish gray and brown, firm, sandy, with coral fragments and gravels.
20									
	x		5 6 7	62.5	63.6				
25									End boring at 23.5 feet. ▽ Water level at 0.9 feet.
30									

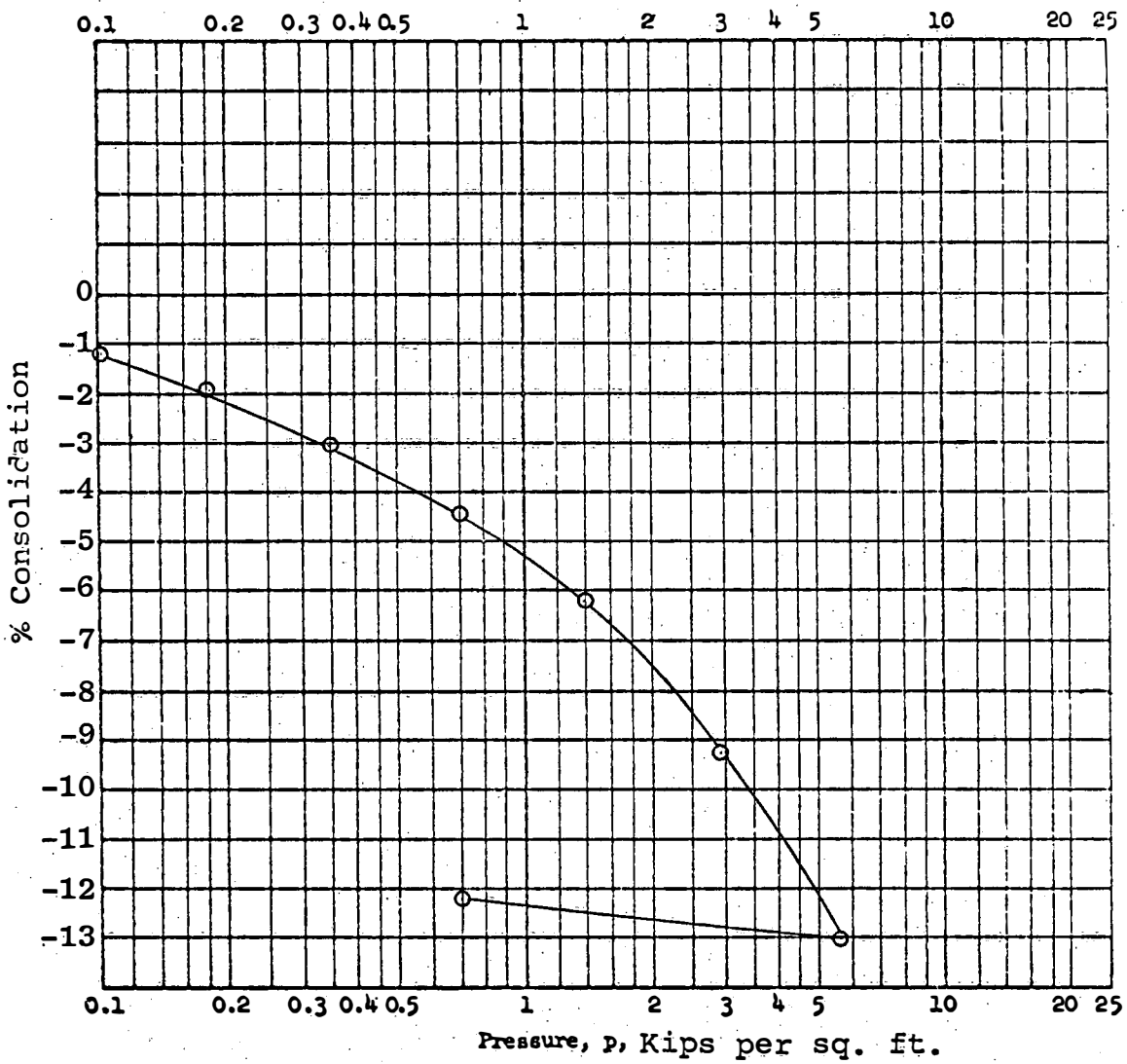
Plate A4



Type of Specimen	Undisturbed	Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	104.3 %	w_f	76.7 %
Overburden Pressure, p_o	T/sq ft	Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c	T/sq ft	Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	42.4 lb/ft^3		
Classification	ML				
LL		Project	Kaopa Subdivision Unit 3B		
PL			Lone Star Hawaii		
Remarks	Water added at 700 PSF	Area	W. O. 378		
		Boring No.	B1	Sample No.	
		Depth El	2'	Date	10-20-76

CONSOLIDATION TEST REPORT

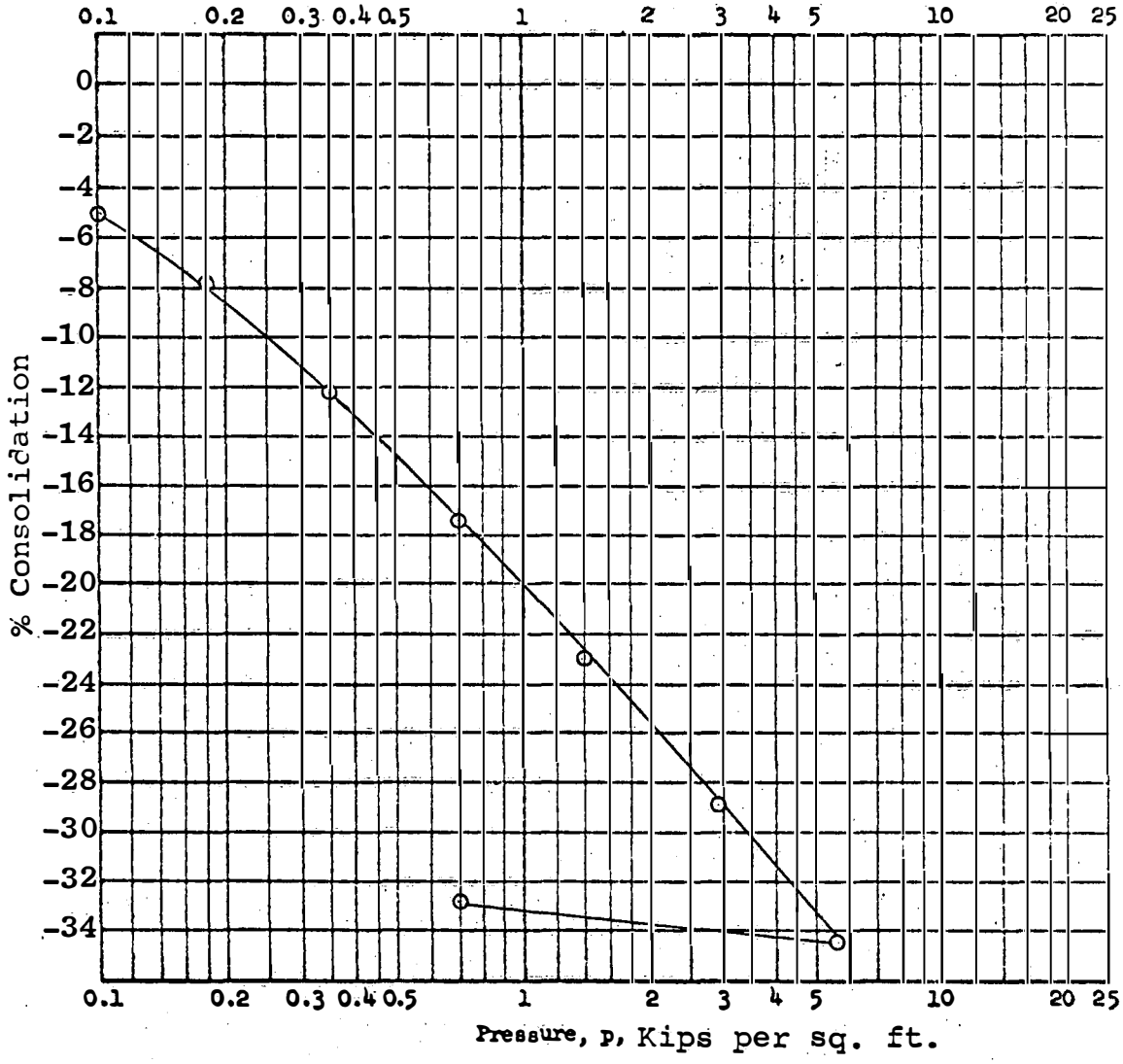
Plate B1



Type of Specimen	Undisturbed	Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	50.6 %	w_f	38.0 %
Overburden Pressure, p_o	T/sq ft	Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c	T/sq ft	Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	72.0 lb/ft^3		
Classification	ML				
LL		Project	Kaopa Subdivision Unit 3B		
PL			Lone Star Hawaii		
Remarks	Water added at 700 PSF	Area	W. O. 378		
		Boring No.	B1	Sample No.	
		Depth El	28.5'	Date	10-20-76

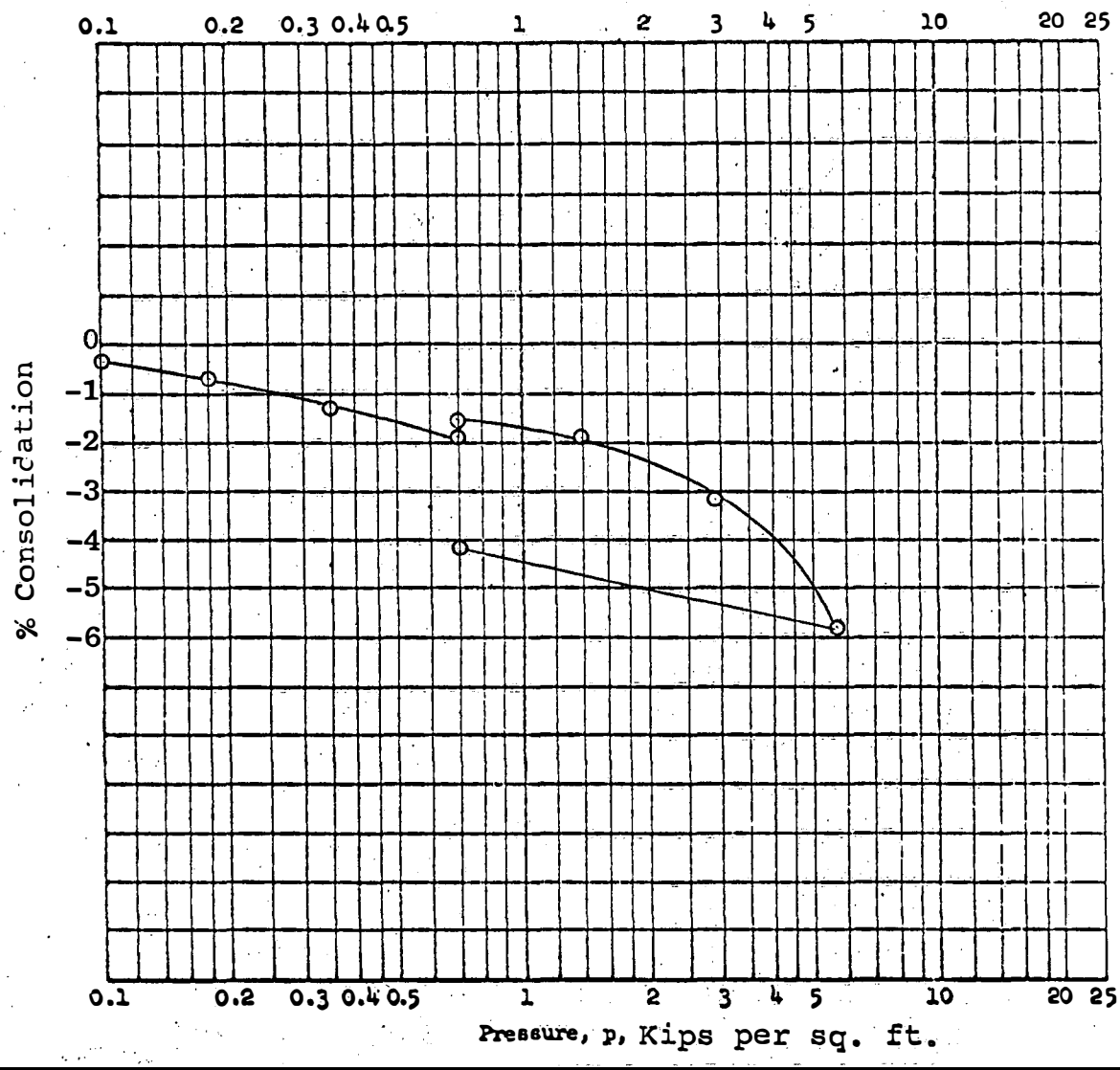
CONSOLIDATION TEST REPORT

Plate B2



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	129.3 %	w_f	65.5 %
Overburden Pressure, p_o	T/sq ft	Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c	T/sq ft	Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	37.9 lb/ft^3		
Classification MH					
LL		Project	Kaopa Subdivision Unit 3B		
PL			Lone Star Hawaii		
Remarks Water added at 700 PSF		Area	W. O. 378		
		Boring No.	B2	Sample No.	
		Depth El	6'	Date	10-20-76
		CONSOLIDATION TEST REPORT			

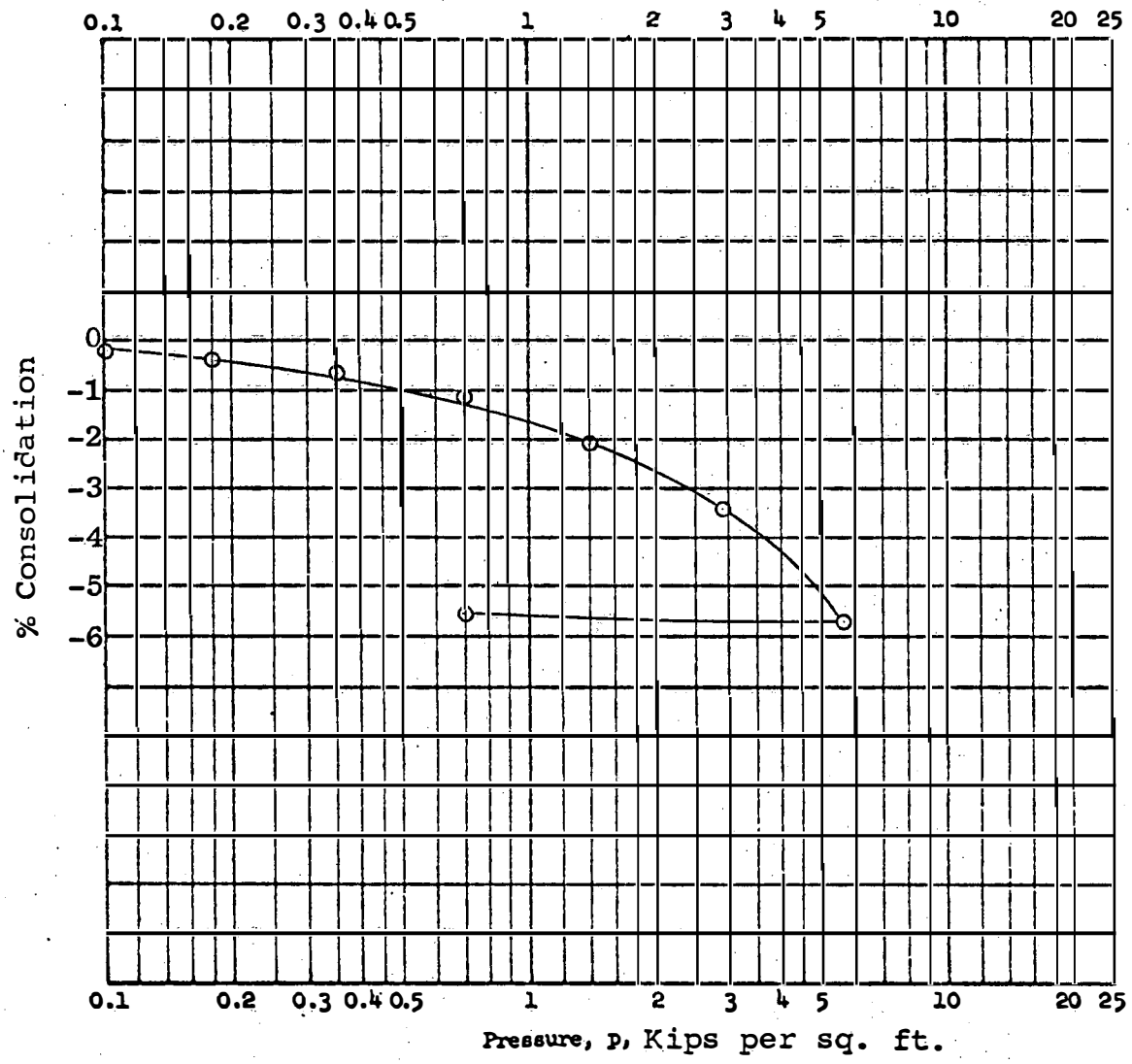
Plate B3



Type of Specimen Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	33.9 %	w_f	49.6 %
Overburden Pressure, p_o	T/sq ft	Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c	T/sq ft	Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	84.3 lb/ft^3		
Classification MH					
LL		Project	Kaopa Subdivision Unit 3B		
PL			Lone Star Hawaii		
Remarks Water added at 700 PSF		Area	W. O 378		
		Boring No.	B2	Sample No.	
		Depth / El	15'	Date	10-20-76

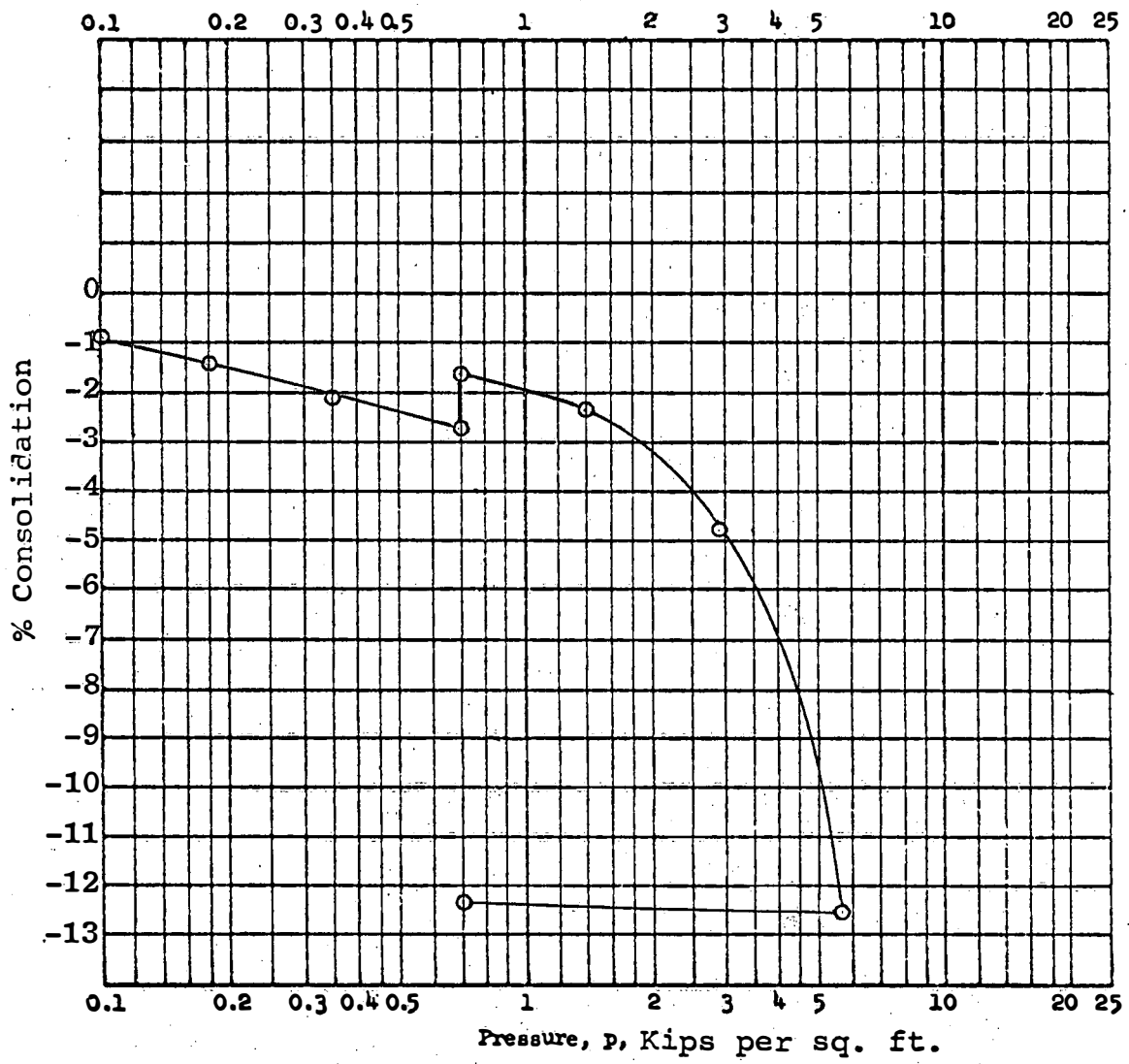
CONSOLIDATION TEST REPORT

Plate B4



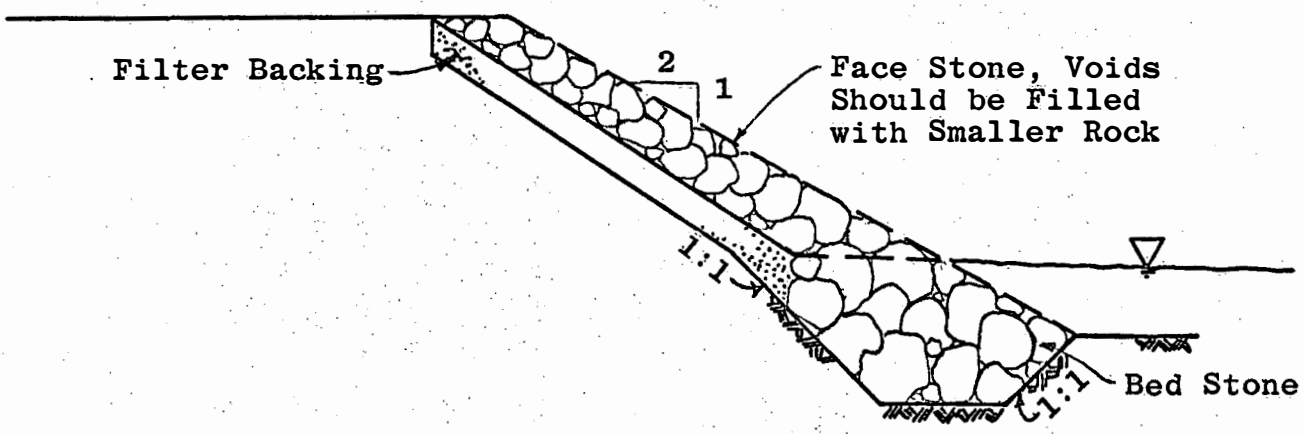
Type of Specimen Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	60.8 %	w_f	49.0 %
Overburden Pressure, p_o	T/sq ft	Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c	T/sq ft	Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	62.9 lb/ft^3		
Classification ML					
LL		Project	Kaopa Subdivision Unit 3B		
PL			Lone Star Hawaii		
Remarks Water added at 700 PSF		Area	W. O. 378		
		Boring No.	B3	Sample No.	
		Depth El	19'	Date	10-27-76
		CONSOLIDATION TEST REPORT			

Plate B5



Type of Specimen	Undisturbed	Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	63.6 %	w_f	72.2 %
Overburden Pressure, p_o	T/sq ft	Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c	T/sq ft	Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	62.5 lb/ft^3		
Classification	MH				
LL		Project	Kaopa Subdivision Unit 3B		
PL			Lone Star Hawaii		
Remarks	Water added at 700 PSF	Area	W. O. 378		
		Boring No.	B4	Sample No.	
		Depth El	22'	Date	10-27-76
		CONSOLIDATION TEST REPORT			

Plate B6

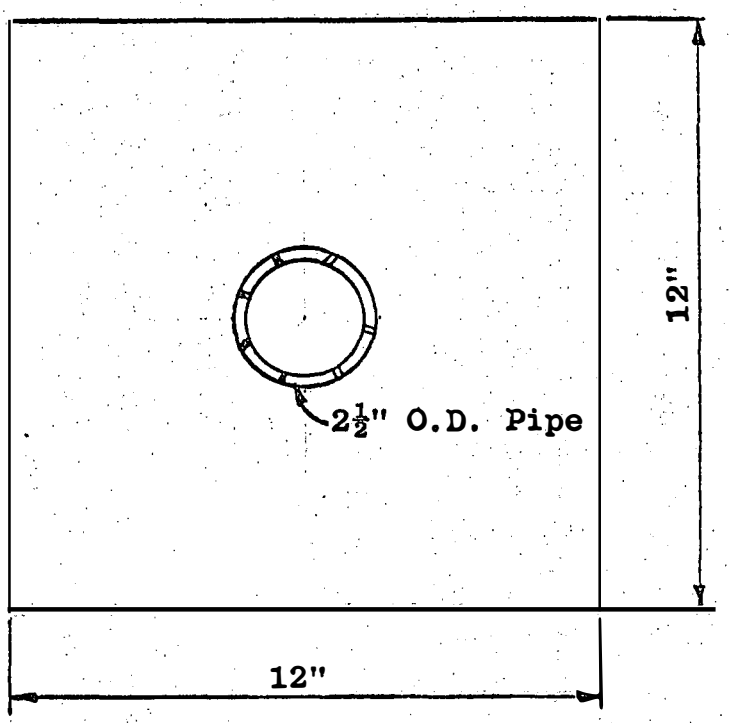


ROCK-SLOPE PROTECTION

No Scale

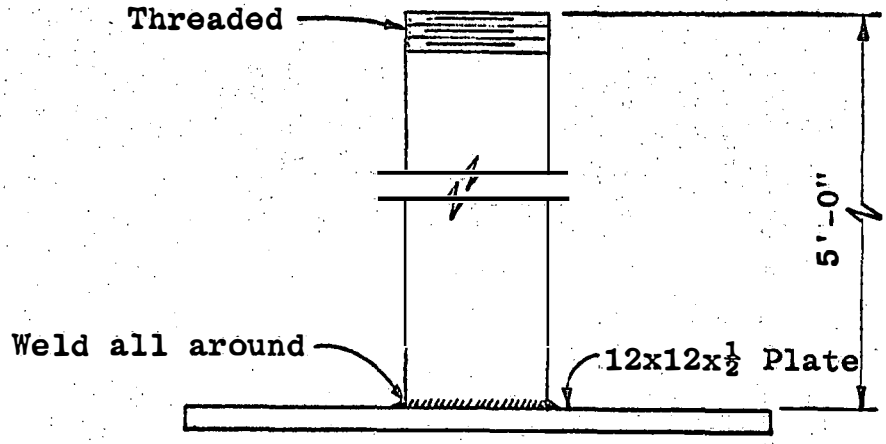
W. O. 378

Plate 1



PLAN

Note: During installation, place larger pipe around gage for protection against heavy equipment.



ELEVATION

SETTLEMENT GAGE DETAIL

W. O. 378

Plate 2

True North

Project limit

End Pipe
Inv.= 0.17

LAKE

Conservation Line

169°16'13" — 1624.35

End Pipe
Inv.= -3.67

B4 B4 B3 B3

18" RCP @ 1.0%

84"xCP @ 0.42%

Exist. D54

Project limit

St. mon.

343°15'18" — 855.09
349°15'13".52 — 885.86

Mon. to Mon. (Ground)
(Record)

343°16'39" — 436.84 Mon. to Mon (Ground)
349°16'13" 53 — 436.81 (Record)

KEOLU DRIVE

KAOPA SUBDIVISION UNIT 3A1

KAOPA SUBDIVISION UNIT 3A2

AKEA PLACE

Grading limit

Drain Line "B"
Connect to existing 48" RCP @ ℄
Inv.= 1.29

DMH-2
Drain Line "C"
Demolish exist. headwall and construct new drain manhole as shown on Sht. 2
Relocate exist. 18" pipe as required to connect to new manhole.

AKIOHE ST.

Match line

End Pipe
Inv.= -1.81

End Pipe
Inv.= 4.19

R=835.00

169°16'13" — 97.40

169°16'13" — 223.68

Conservation Line

169°16'13" — 1624.35

B2 B2 B1 B1

18" RCP @ 0.5%

36" RCP @ 0.77%

PROJECT LIMIT

KAOPA SUBDIVISION UNIT 1A1

Exist 8'-0"x 5'-6" Box Culvert

343°15' — 133.00

Exist.

343°16'39" — 470.58 Mon. to Mon. (Ground)
349°16'19".63 — 468.69 (Record)

343°16'39" — 271.16 Mon. to Mon. (Ground)
349°16'13" — 63 273.56 (Record)

343°16'13" — 186.77 Mon. to Mon. (Ground)
70 349°16'19" — 186.50 (Record)

KEOLU DRIVE

Existing St. Mon. Elev. = 10.98

Existing St. Mon. Elev. = 11.42

AKALA PLACE

Drain Line "E"
Connect to existing 18" RCP @ ℄
Inv.= 4.96

DMH-1
Drain Line "D"
Demolish existing headwall and wingwall and construct new drain manhole as shown on Sht. 2
Relocate exist. 18" pipe as required to connect to new manhole

PLAN

10 0 10 50 100
Scale in Feet

Approx. Location of Borings taken October 1976

Approx. Location of Borings taken May 3, 1974

EARTHWORK QUANTITIES 1st. STAGE FILL

EXCAVATION : 0 C.Y.
EMBANKMENT: 40,300 C.Y.
TOTAL AREA TO BE GRADED = 5.0 ACRE
TMK : 4-2-02 & 4-2-04

NOTE TO CONTRACTOR :

1. The Contractor shall verify the alignment and location of the existing drain line and continue this alignment for the drain line extension.
2. Street monument distances are from "As-Built" plans on file at the Division of Engineering.

Future Finished Grade as shown on Grading Plan

Conservation Line

Future R/W

KEOLU DRIVE

100'

25'

15'

12"

Top Bank

2:1 Slope

1st Stage Fill

3:1 Slope

Condition @ Drain Line "C" & "D" only.

TYPICAL 1ST STAGE FILL SECTION
Scale : 1"= 20'

PROJECT SITE

KEOLU DRIVE

KALANIANAOLE HWY.

To Waimanalo

LOCATION PLAN
TMK: 4-2-02 & 4-2-04

APPROVED FOR GRADING ONLY :

DIRECTOR & CHIEF ENGINEER, DPW — DATE

CHIEF, DIVISION OF ENGINEERING, DPW — DATE

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering
1236 South King Street Honolulu, Hawaii
W.O. 378

M & E PACIFIC, INC.
GANN-LOW-TOM & HARA, INC.
ENVIRONMENTAL CONSULTANTS
HONOLULU, HAWAII

KAOPA UNIT 3-B
KAILUA, KOOLAUPOKO, OAHU, HAWAII
TMK: 4-2-02 & 4-2-04

GRADING PLAN
1 ST STAGE FILL

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
DATE

DESIGNED BY
DRAWN BY
CHECKED BY
SUBMITTED BY
REVIEWED BY
APPROVED BY
APPROVED BY:
CHIEF, DIV. OF ENG. (HEPO)
ASST. CHIEF (HEPO)
DEPUTY TRAFFIC ENGINEER, DEPT. OF TRAFFIC
CHIEF, SOIL OPERATIONS
DATE
BY
REVISION

SHEET 1 OF 2 SHEETS DWG. NO.

FILE POCKET FOLDER NO.